Cambridge International A Level

Cambridge Assessment International Education
Cambridge International Advanced Level

CANDIDATE NAME		
CENTRE NUMBER		CANDIDATE NUMBER

7957641337

MATHEMATICS **9709/72**

Paper 7 Probability & Statistics 2 **(S2)** **February/March 2019**

1 hour 15 minutes

Candidates answer on the Question Paper.

Additional Materials: List of Formulae (MF9)

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** the questions in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 50.

This document consists of **13** printed pages and **3** blank pages.

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1 The masses of a certain variety of plums are known to have standard deviation 13.2 g. A random sample of 200 of these plums is taken and the mean mass of the plums in the sample is found to be 62.3 g.

(i) Calculate a 98% confidence interval for the population mean mass. [3]

(ii) State with a reason whether it was necessary to use the Central Limit theorem in the calculation in part **(i)**. [1]

2 The independent random variables X and Y have the distributions N(9.2, 12.1) and N(3.0, 8.6) respectively. Find $P(X > 3Y)$. [5]

3 At factory A the mean number of accidents per year is 32. At factory B the records of numbers of accidents before 2018 have been lost, but the number of accidents during 2018 was 21. It is known that the number of accidents per year can be well modelled by a Poisson distribution. Use an approximating distribution to test at the 2% significance level whether the mean number of accidents at factory B is less than at factory A. [6]

4 The lifetimes, X hours, of a random sample of 50 batteries of a certain kind were found. The results are summarised by $\Sigma x = 420$ and $\Sigma x^2 = 27\,530$.

(i) Calculate an unbiased estimate of the population mean of X and show that an unbiased estimate of the population variance is 490, correct to 3 significant figures. [3]

(ii) The lifetimes of a further large sample of n batteries of this kind were noted, and the sample mean, $\overline{X}$, was found. Use your estimates from part **(i)** to find the value of n such that $P(\overline{X} > 5) = 0.9377$. [4]

5 The number of eagles seen per hour in a certain location has the distribution Po(1.8). The number of vultures seen per hour in the same location has the independent distribution Po(2.6).

(i) Find the probability that, in a randomly chosen hour, at least 2 eagles are seen. [2]

(ii) Find the probability that, in a randomly chosen half-hour period, the total number of eagles and vultures seen is less than 5. [3]

Alex wants to be at least 99% certain of seeing at least 1 eagle.

(iii) Find the minimum time for which she should watch for eagles. [3]

6 The time taken by volunteers to complete a certain task is normally distributed. In the past the time, in minutes, has had mean 91.4 and standard deviation 6.4. A new, similar task is introduced and the times, t minutes, taken by a random sample of 6 volunteers to complete the new task are summarised by $\Sigma t = 568.5$. Andrea plans to carry out a test, at the 5% significance level, of whether the mean time for the new task is different from the mean time for the old task.

(i) Give a reason why Andrea should use a two-tail test. [1]

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(ii) State the probability that a Type I error is made, and explain the meaning of a Type I error in this context. [2]

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You may assume that the times taken for the new task are normally distributed.

(iii) Stating another necessary assumption, carry out the test. [7]

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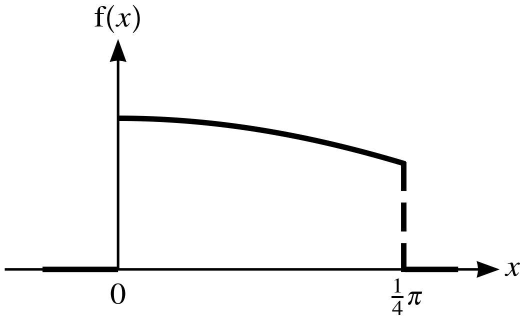

A random variable X has probability density function given by

$$f(x) = \begin{cases} (\sqrt{2})\cos x & 0 \leqslant x \leqslant \frac{1}{4}\pi, \\ 0 & \text{otherwise,} \end{cases}$$

as shown in the diagram.

(i) Find $P(X > \frac{1}{6}\pi)$. [2]

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(ii) Find the median of X. [4]

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(iii) Find E(X). [4]

Additional Page

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